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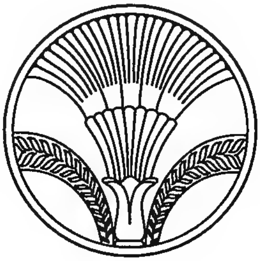

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MAIZE:

AN ATTEMPT AT CLASSIFICATION

—BY—

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DIRECTOR OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION.

GENEVA, DECEMBER, 1883.

PRINTED FOR PRIVATE DISTRIBUTION ONLY:

BOTANICAL FRIENDS WILL CONFER A FAVOR BY FORWARDING CRITICISMS AND SUGGESTIONS TO THE AUTHOR.

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MAIZE.

AN ATTEMPT AT CLASSIFICATION.

HISTORICAL NOTES.

The races of Indian corn now recognized by farmers,—the pops, the flints, the softs, the sweets, and the dents,—seem to have been known from a distant antiquity. The pop corn can perhaps be identified as the sacred corn of Titiaca, for the rice pop forms the cone-shaped ears, and according to Rivers and Tschudi, the Peruvians worshiped ears of maize that were cone-shaped, and Squiers describes a variety at present in cultivation in this region as scarcely three feet high, bearing ears not longer than one's finger, and covered with vitreous grains. The rice pop has angular and pointed kernels, and Dobrezhoffer names in Paraguay a corn with these characteristics. Flint corn was found in cultivation by the northern Indians by the earliest visitors, and hard corn, perhaps flint, is mentioned in Peru by Garcelasso de la Vega, and in Paraguay by Dobrezhoffer. Soft corn seems first to have been described as Tuscarora, found in cultivation by the Tuscarora Indians upon the settlement of North Carolina, and brought by them to their reservation in New York State, upon their removal thither in 1712. Sweet corn is said to have been taken to Massachusetts from the region of the Susquehanna upon the return of Sullivan's expedition in 1779, and this appears to have been an eight-rowed sweet. Another variety, probably the Evergreen, is mentioned incidentally by Bordley in 1801. Dent corn is vaguely described by Acosta and other early writers, but as this is one of the kinds which have been found in the Peruvian *huacas*, its antiquity is placed beyond question.

Among the so-called species of maize of some authors is *Zea rostrata*, Bon. of Peru, with mucronate seeds; *Z. macrocarpa*, Klotz. of Peru, a soft corn; and *Z. curagua*, Mol., of Chili, the seeds flinty.

Among the varieties of corn which have been traditionally derived from the northern Indians, are the King Philip and Sioux flint; the Squaw, Tuscarora and Wyandotte soft, and the sweets.

The intermixture of the several varieties of corn was well known to the aborigines, and was attributed, by some of them at least, to the roots and small fibers reaching to, and communicating with each other. This mixture they do not seem to have been concerned about, as very many of the more full descriptions of the crops of North American Indians speak of the variety of colors not only of ears, but of the kernels intermixed upon the ear. It hence seems all the more surprising that our variations not only should have been handed down to us so well defined and so perfectly retaining their characteristics, but that these characteristics should have been so firmly maintained under the careless system of cultivation pursued by the European colonists, as well as by the present American farmers.

BOTANICAL RELATIONS.

In view of the history of maize, it has always seemed to me unreasonable to class the various races under one botanical species, and yet with the current statements and beliefs of its constant intercrossings and changes, no other conclusion seemed tenable. It is therefore with satisfaction that I offer this paper to the public, the data being derived from a collection of 231 kinds of ear corn from various localities, and the growing together in the New York Experiment Station garden of 135 different kinds of seed, from which 404 representative ears were selected. From these ears every kernel of divergent type has been culled, and two cross-sections made, for the purpose of study.

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PERMANENCE OF TYPES.

In all the races we find a great variety of color in the kernel, especially so in the soft race, where the color penetrates into the structure of the kernels which possess corneous matter through current hybridization. In the other races of corn, the red color, often passing to a black purple, is a very strong character, the red ears usually showing no change in color of kernel through current hybridization. The cobs (glumes) also may be red or white, irrespective of the color of the kernel. The number of rows varies in all the varieties with which we are acquainted, but yet one number is usually the most prevalent, and from pure seed the variation seems to be within well defined limits. Thus, the Waushakum, a pedigree corn of the Canada type, is nominally 8-rowed, but yet ears 6-rowed, 10-rowed and 12-rowed are of occasional occurrence.

The sub-races which our collection enables us to separate, are shown more clearly to the eye than by description. On account of the interfertilization which has taken place between the various types which in localities are grown together, often two or more types can be selected from one crop, but there seems a tendency for each type to maintain itself, so that usually the various ears can be readily referred to their proper types.

THE POP SUB-RACES.

Pop corn presents three well marked sub-races : the common pop, pearl pop and rice pop.

Common Pop is usually eight rowed, the ears cylindrical, long, with small cob; small stalked; kernels rounded ; red ears rarely, if ever, occur.

Through hybridization, apparently, it imperceptibly changes its type and its capacity to pop over the fire, starch becoming visible in its kernels. Its kernels may perhaps be found upon the ears of the pearl pop sub races, but are doubtfully recognized. They do not occur with the kernels of the rice pop. The kernels of the other sub-races of pop do not appear with its kernels. Sweet corn kernels may appear through current hybridization. The greatest variation* in structure of kernels from current hybridization or otherwise, as found by us, is shown in Fig. 6.

When flint structured corn raised from pop seed was planted, variations occurred as shown in Fig. 7, as taken from five ears.

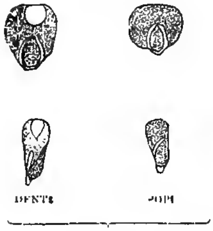

Fig. 6.

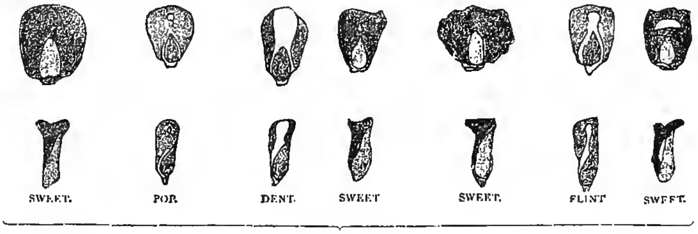

Fig. 7.

Pearl Pop is many rowed, the kernels very hard and flinty, unusually deep, often triangular in section and with a polish that gives the name to the class. The ears taper slightly, and red ears are abundant. Cone-formed ears sometimes occur. There is usually a tendency to visible starch in small quantity in the structure ; kernels of sweet corn appear through current hybridization ; some kernels also which can be referred doubtfully to the flint.

The greatest variation observed is given in Fig. 8.

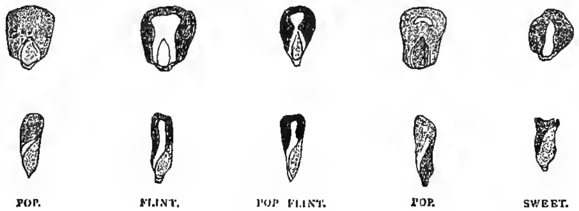

Fig. 8.

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* In the illustration of variations occurring in the various races or types, that from current hybridization is figured well as those from the use of hybridized seed.

Rice Pop is many rowed ; the tendency to cone-shape in the ear is very marked ; kernels imbricated on the cob ; the stalk is small and the kernels round strongly over the butt of the cob. Ears of the pearl form, however, occur. Red ears are very common. Sweet kernels occur through current hybridization, as also kernels which may be referred to the flint, and doubtfully to the dent type. The extreme variations found are given in Fig. 9.

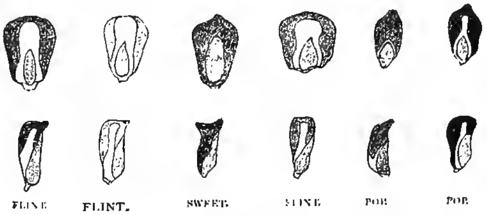


Fig. 9.

As offering some clue as to the permanency of types, we give in Figure 10 the variations observed in the crop from sweet kernels taken from the common pop ear : in Fig. 11, sweet kernels from the pearl pop ear, and in Fig 12, sweet kernels from a rice pop ear, being used as seed.

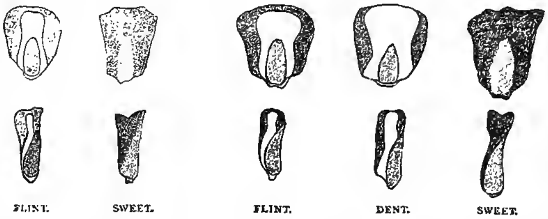


Fig. 10.

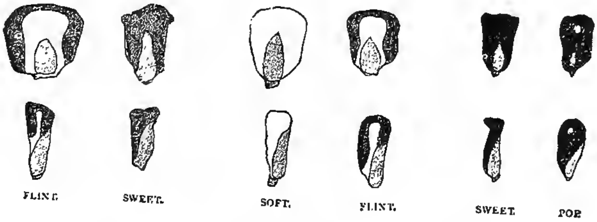


Fig. 11.

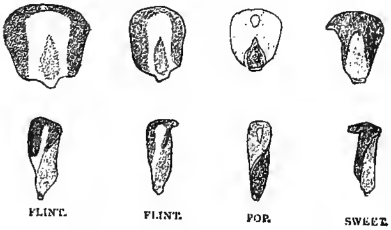


Fig. 12.

THE FLINT SUB-RACES.

Flint ears show likewise three sub-races, but are not as easily described as are the pops, though they may be readily recognized in certain localities ; one northern, another intermediate, the third southern in its character. These types are frequently intermingled in a crop, but the tendency for each to produce its own type is well marked, and collections of most divergent ears at first sight can usually be referred to their proper position. As these sub-races were not recognized at the time of the planting of our seed, we offer in Figure 13 the variations in the type of kernel noted in the ears of the flint race by which it will be seen that rarely a dent type kernel is to be found. In the sweets crossed upon flints, however, the sweet ears contained the soft and doubtful dent type of kernel figured.

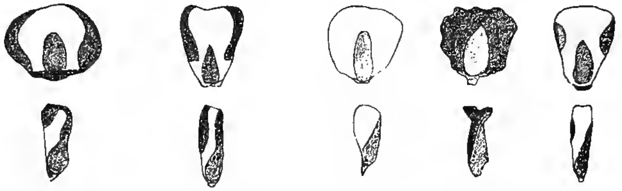


Fig. 13. SWEET CROSSED ON FLINT.

Canada Corn—The ear cylindrical, shortish, usually 8-rowed; the kernel rounded, stalk small, Type—Canada Yellow.

New England—The ear tapering, long, usually 12-rowed, but often 8-rowed in varieties. The stalk large. Type—Golden Sioux and New England Twelve-rowed.

Southern Hominy—The ear tapering, the kernels strongly rounding over the butt to meet the small stalk; many rowed, the kernels very flinty and the corneous portion thickened at the sides and shallow at apex. Type—Southern Hominy. Our collection, however, contains too few ears for satisfactory determination.

SOFT CORN SUB-RACES.

The soft corn shows in our collection two types, but our material is not sufficient for a satisfactory definition. It is probable that a third type exists, as kernels of this structure are occasionally to be found on sweet ears of the third type, as also on some dents. The variations in structure of kernel that were observed are noted in Figure 14.

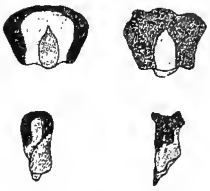


Fig. 14.

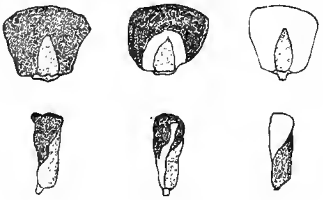


Fig. 15.

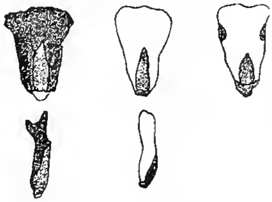


Fig. 16.

Northern—The ear cylindrical, shortish, 8-rowed; the stalk small. Type—One ear from Red River of the North.

Tuscarora—The ear tapering, long, 8 to 12-rowed, the stalk rather large. Type—Tuscarora and Squaw corn. The Squaw corn very subject to current hybridization from the flints.

SWEET CORN SUB-RACES.

Sweet corn ears present also three sub-races, but as the distinction was not recognized at the time of planting, our records of variation are defective. Two of these sub-races are very distinct and evidently do not influence each other's kernels by current hybridization.

Early—The ears cylindrical, usually 8-rowed, the kernel but slightly crinkled; rounded, the stalk small. Current hybridization from flint pollen and from soft pollen. Type—Eight-rowed Sweet of some seedsmen. The variations observed in the kernel are shown in Figure 15.

Medium—The ears tapering, usually 12-rowed. The kernel slightly crinkled, the stalk rather large; current hybridization from flint pollen. Type—Asylum.

Large Late—The ears tapering, many rowed; the kernel wrinkled and wedge-shaped, rounding strongly over the butt to meet the small stalk. Variation by current hybridization from dent pollen and perhaps soft pollen. Type—Stowell's Evergreen. The variation in type of kernel is shown in Figure 16.

THE DENT SUB-RACES.

Dent corn presents three sub-races, which a little experience very readily separates

Eight-Rowed—The ear cylindrical, usually 8-rowed; the kernel rounded and broad, creased; the stalk small. Type—Benton or Yankee. The variation observed was to the soft kernel type, as shown in Figure 17.

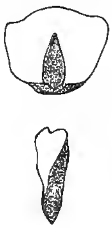

SOFT.

Fig 17.

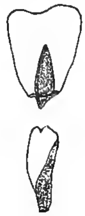

SOFT.

Fig. 18.

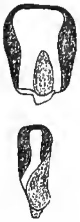

FLINT.

Fig. 19.

Tennessee—The ear tapering, 12 or 14-rowed, rather long, the stalk above medium size; the kernels polygonal, so as to form a wedge shaped sulcus between the rows. Type—Watson and Tennessee. Blount's Prolific is an 8 or 10-rowed variety of this type. The variations observed in the kernel were to the soft type, as shown in Figure 18.

Western—The ear tapering, usually short; at times cone-shaped or long-oval; the kernels rounding strongly over the butt to meet the small stalk; kernels wedge-shaped, thus leaving no sulcus between the rows. Types—Queen of the Prairie and Proctor's Bread. The variation observed is shown in Figure 19.

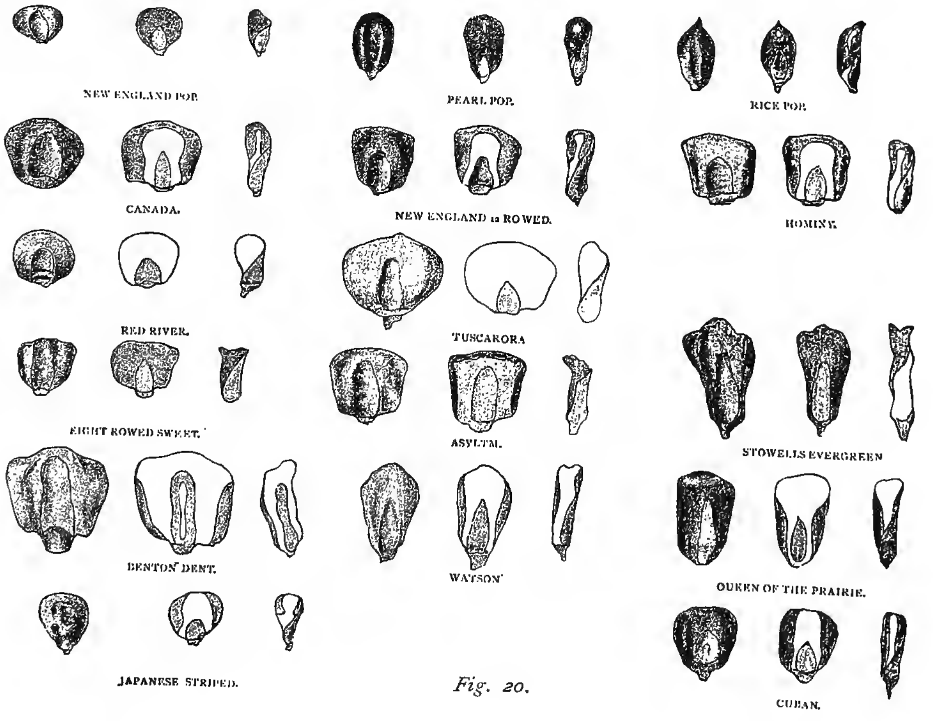
UNCLASSED TYPES.

We have in our collection two ears, which cannot be classed with the other races, and which I therefore provisionally term INTERMEDIATE. One is a variety called Cuban, and grown in South Florida; the ear cone-shaped, the kernel rounding over the butt to meet the small stalk, the kernels excessively flinty, the corneous matter wanting at the summit, but strongly developed at the sides. The other, the Japanese Striped Maize, the kernel, however, less flinty than in the Cuban.

THE RACES GROUPED.

We will now group our races and sub-races, as herein established, in an illustrated table.

SUB-RACE A. SUB-RACE B. SUB-RACE C.


NEW ENGLAND POP. CANADA. RED RIVER. EIGHT ROWED SWEET. BENTON DENT. JAPANESE STRIPED.

PEARL POP. NEW ENGLAND 12 ROWED. TUSCARORA. ASYLUM. WATSON.

RICE POP. HOMINY. STOWELLS EVERGREEN. QUEEN OF THE PRAIRIE. CUBAN.

Fig. 20.

GENERALIZATIONS.

A critical examination of the 3733 ears of our crop in their relations to the seed planted, and the opportunities for interfertilization, would seem to sufficiently justify the following general conclusions :

Cross-fertilization of the current year is manifested on the kernel, and not on the ear, and, as has been sufficiently noted, this influence is not reciprocally strong as between the races, or even the sub-races, and the resistance to current hybridization is more strongly marked in some races, sub-races or varieties than in others.

Hybridization in the seed used produces a variety of ears, but each ear in general is quite close to one of the parent types ; an intermixture of kernel in no case seems to be produced. Reciprocal fertilization between two races does not seem to be productive of equal effect.

An inference gathered from observation rather than founded upon recorded data leads me to believe that there is a greater resistance to cross-fertilization between sub-races than between varieties of the same sub-race. There seems also a tendency for each type to maintain its own position, even when grown with other types, and there seems to be occasionally a transfer of one sub-type kernel to another sub-type of ear. There are exceptions, however, occasionally to be noted, but not of frequent occurrence, where intermediate characters appear, to the ear and its kernel.

POD OR HUSK CORN.

The Pod or Husk corn is a variety wherein each kernel is enclosed in a husk, as well as the ear. We have in our collection two races, the one a flint; the other a dent. The flint can be placed in sub-race A of our classification. Our dent ears belong, apparently, to the two sub-races B and C of our classification. It thus seems probable that this pod corn should not be classed as a separate race, unless it be solely for convenience. We present illustrations of the kernel type : Fig. 21.

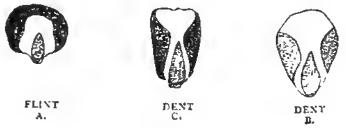


Fig. 21.

Of the flint type we have but one ear. This is 10-rowed, nearly cylindrical, shortish, rather small stalked, the husk abundant.

Of the dent race, sub-race B, but one ear. This tapering, longish. 10-rowed, the stalk a little large, the kernels rounding over the butt. The kernel apparently polygonal, that is, if compressed in an unpodded ear, would have a sulcus between the rows.

Of sub-race C, we grew many samples from seed exposed last year to hybridization from several varieties of sweets. Last year's crop yielded podded ears and unpodded ears. So far as examined the podded kernels were all a yellow dent ; the unpodded ears all yellow dent or yellow dent and sweet, or red dent and red sweet intermingled. This year's seed was a selection of podded kernels, unpodded dent, and sweet kernels, and was grown subject to hybridization from all the other races, but yet on account of the lateness of the silking, pollen from many of the earlier varieties was excluded. Of this year's crop some ears were fastigiate, as was also the case last year ; others heavily podded ; others lightly podded. The kernels of all of the 86 ears, so far as examined, were of a yellow or deep-red colored dent. The unpodded ears of this year's crop, 122 in number, vary from 12 to 24 rows, as follows :—8 were 12-rowed, 19 were 14-rowed, 23 were 16-rowed, 34 were 18-rowed, 30 were 20-rowed, 7 were 22-rowed, and 1 was 24-rowed. The red dent seed planted yielded 14 red dent ears, and 5 white and yellow dent ears. From the unpodded seed, 132 plants yielded 10 podded and 93 unpodded ears ; from the podded seed, 166 plants yielded 76 podded and 29 unpodded ears. The sweet corn from unpodded ears yielded some sweet ears, but mostly sweet mixed with dent.

The effect of current hybridization was observed on the unpodded ears in color, some kernels being red, red blotched and pink. As all the evidence in the preceding study is in favor of the view that change of kernel is produced by current hybridization, we may fairly assume that all the ears containing sweet kernels were sweet ears, and that their dent kernels were formed by the prevalent pollen ; yet

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So distinct, however, are these starred species, that the omission of the star would create no confusion even in systematic botany. It is difficult to believe that the sub-races I have figured and described are not also to receive an agricultural classification, when sufficient material for study has been collected, but at present they can remain as varieties a, b and c of their respective starred species. My purpose is to assist in creating an agricultural botany which shall be of service for the study of economic relations, and whether I class the species or fixed forms under the head of agricultural species or of species seems of little consequence, except that the systematic botanist can use my evidence and remove the * in such cases as seems to him to be advisable.

PARALLELISM OF STRUCTURE OF MAIZE AND SORGHUM KERNELS.

A Paper read before Section F., Minneapolis Meeting of the A. A. A. S., 1883, by E. Lewis Sturtevant, M. D., Geneva, N. Y.

If kernels of flint, pop, sweet and Tuscarora maize be split parallel to the germ, each race will be seen to present a definite arrangement of structure. Thus, the flint corn exhibits a germ surrounded by starchy matter and this in turn by a corneous envelope. In the pop-corn proper the germ is inclosed in the corneous matter, the starchy matter being absent except as the pop variety entrenches upon the flints. The sweet corn has a similar structure to the pop, but the corneous matter is translucent and wrinkled. In the dents the corneous matter occupies the sides, the starchy matter extending to the summit and including the germ. In the Tuscaroras the corneous matter is entirely absent, and only the germ and the starchy matter are to be made out.

If kernels of sorghum be split in like manner, a similar arrangement is to be found. Thus, the seed of the varieties distributed under the name of "Dhourra," "African Wheat," and "Millo Maize," correspond to the flint-corn type, the germ surrounded by starchy matter, and this in turn included in a corneous envelope. In "Rice Wheat" we find the pop-corn type, germ and corneous matter, no starchy portion being visible. In "Neeazana" we have a structure modeled upon the dent corns, and in "Chinese Sugar Cane" a structure modeled after the Tuscaroras, a starchy matter and germ without visible corneous matter.

On account of the confusion of names it seems unnecessary to introduce further examples, although an examination of some thirty or forty so-called varieties show that this observation is founded upon general characters.

In the case of the maize kernel we might assume that these differences have been produced by conscious selection, the kernel being the portion used, and the various races being fitted for uses founded upon the structure. In the case of the sorghum, however, this supposition would scarcely answer, as the kernel is of small size, and apparently has not been subjected to conscious selection. In view of this parallelism of structure, together with the probability that a like selection has not been exercised upon both, it seems safe to infer that these structural differences within each genus, have more meaning than simple variety differences, and that the same causes have been at work, independently of man's conscious selection, to produce the forms of kernel-structure which in Zea and Sorghum have such well marked and allied characteristics.

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